# SEA SERPENTS, SEALS AND CŒLACANTHS

## An attempt at a holistic approach to the identity of large aquatic cryptids

**Darren Naish**

After a century of analytical exploration of reports of large aquatic cryptids, where do we stand? Are we any closer to understanding the true nature of these beasts, or is cryptozoology being led astray by poor scholarship and outdated concepts of prehistoric life? Darren Naish takes a critical view of the field from the perspective of a modern palaeontologist and sees how cryptozoological concepts measure up against the latest palaeontological evidence.

If we are to accept that at least some of the eyewitness evidence for the existence of large aquatic cryptids (sea and lake monsters) is compelling, a rational and zoological approach to the identities of such animals must combine knowledge of the fossil record with that of the cryptozoological data. With more than a century's worth of analytical review behind us, where do we stand now, at the start of the 21st century?

For as long as the field has been regarded as a subdiscipline, cryptozoology has been linked with palaeontology – the study of fossil organisms – and fossil taxa have been frequently regarded as potential cryptid identities. Despite this, the literature proves that few cryptozoologists, including the founder of the science, are well versed in palaeontological studies while, similarly, few palaeontologists are even aware of the cryptozoological literature: a modern synthesis of the two is thus required. What we now know about many fossil reptile and mammal taxa shows that cryptozoological scenarios where 'survivorship' is invoked are nearly always highly flawed. No known group of fossil or extant animals (including cœlacanth and megamouth sharks) provide an analogue for the hypothetical survival of ancient marine reptile and mammal lineages and suggestions of 'survivorship' run counter to abundant research on the quality and nature of the fossil record, and on the timing of geological events (such as mass extinctions).

Furthermore, because these suggested identities are based only on the restored appearances of fossil animals, such identities are not only tenuous but generally based on outdated views. This is the idea of historical contingency: 'survivorship' scenarios have not just been based on outdated restorations, but have also been limited to those fossil taxa represented in the popular literature. Cryptozoologists have, however, missed some palaeontological data that has a direct bearing on their speculations – the study of ghost lineages in the fossil record opens up a new area of discussion.

The absence of physical data, and the ambiguity inherent in the few photographic records that exist, requires that scientific cryptozoologists cannot yet propose identities for aquatic cryptids. Bille's summary of the current situation is the best one: 'There is no clear, unambiguous photographic evidence of sea serpents... Nor are there any known bones, scales, or other hard evidence. Carcasses washed ashore have either been identified as known animals or have been lost before they could be examined by experts... Accordingly, the credibility of the sea serpent largely rests on eyewitness accounts.' [1]

### Why believe in crypids?

It clearly remains possible that species of large extant aquatic animal await discovery. Abundant eyewitness reports suggest that several species of cetacean await official documentation and some of these species have been captured on film, making them among the most reliably documented of all cryptids. [2] Two new species of ziphiid whale were described for the first time in the last decade [3] and probable others have been documented by molecular studies. [4] Startling discoveries of new populations of Megamouth shark (*Megachasma pelagios*) [5] and of the Indonesian cœlacanth (*Latimera menadoensis*) [6] support the view that significant discoveries of large marine animals are still to be made. A theoretical analysis of the discovery rate of large marine animals predicts that as many as 47 such species still await discovery. [7]

Regardless of their contribution to other fields of study, scientists are often viewed with disdain when expressing an interest in cryptozoology: the poor reputation of the field largely being due, unfairly, to the efforts of extremists. Furthermore, those who devote their lives to the study of cryptids are rarely awarded accolade from outside of the field. Consequently, one might conclude that announcing an interest in cryptids

today is a bad career move. This approach is an artefact of our time – few if any contemporary biologists would criticise the efforts of Thomas Huxley (1825-1895), the 19th century evolutionist and supporter of Darwin, yet Huxley at least occasionally supported the existence of sea serpents. [8] Things are changing however. Bauer and Russell, two respected academic zoologists, recently wrote: "As a glance through the pages of the journal *Cryptozoology* will reveal, professional zoologists, anthropologists, linguists, and folklorists, as well as dedicated amateurs, are [..] intrigued by the field, and have established a credible record of objectively analysing data pertinent to unknown animals, or applying data from other fields to cryptozoology." [9] In that cryptozoological writings are rife with fantastic extrapolations that run counter to accepted scientific research, it would be desirable, and satisfactory, that zoologists from all fields comment more widely on cryptozoological issues. In accepting that at least some of the evidence for the existence of certain cryptids is compelling, zoologists should not hesitate to make contributions to the field of cryptozoology.

## The nature of the evidence

Cryptozoological data is, by its very nature, incomplete; subject to witness bias and interpretation; and, further, often victim to the prejudices of a researcher's approach. A good example of the latter is provided by Holiday [10] who interpreted all Loch Ness monster sightings as of a giant invertebrate related to the eight-cm long Carboniferous fossil *Tullimonstrum*. Arguably, it may be that folklorists, disinterested in the idea that reports of cryptids might represent sightings of animals, are immune to such distortions. [11] Their interpretations are clearly discordant with those of us who accept that people are seeing real animals, though albeit influenced by their cultural view of the world. It is also somewhat problematical that some of the most compelling accounts of aquatic cryptids date from the 18th and 19th centuries.

In a review of sea serpent accounts, Bille [12] regarded a select few as among the most important aquatic cryptid accounts of all time. Among these is the 1848 encounter between the frigate *Daedalus* and an immense blunt-headed serpentine creature seen off the Cape of Good Hope. Most writers are familiar with the appearance of this creature due to the rendition published in the *Illustrated London News* under the supervision of the ship's captain. However, an original sketch drawn by Lt Edgar Drummond reveals far less detail, and a creature far more distant, than the ILN illustration. [13] Ellis contends, as did Lee in 1884, [14] that the Dædalus serpent may actually have been a giant squid swimming backwards with the end of its tail above the water surface. [15] Drummond's sketch does not discount this possibility and, furthermore, shows that our 'traditional' view of this account may be more colourful (and impressive) than it actually was. This sighting is thus not such a 'classic' after all.

Certain other reports from the cryptozoological archives may also be discounted as reports of known animals. Another encounter famously depicted in the *ILN* is the 1959 Soay encounter reported by Tex Geddes and James Gavin. The *ILN* illustration depicts a scaly dragon-like reptile with a long neck and serrated dorsal midline. [16] However, Geddes and Gavin's drawings show a blunt, beaked head and a lower body, albeit still with a serrated midline. This profile corresponds to a loggerhead (*Caretta caretta*) or Kemp's ridley (*Lepidochelys kempii*) turtle (**Fig 1**). A creature seen off Sicily in 1877 is also almost certainly a turtle, [17] though the witnesses' description of the object as more than 15 metres in length is problematical.

Another 'classic' sighting, and one regarded as one of the best sea serpent accounts of all time by many cryptozoologists, is the Val Halla encounter of 1905. This sighting is particularly important because the two people who reported it, Michael Nicoll and E Meade-Waldo, were trained, respectable naturalists and were able to observe the animal through binoculars. [18] Nicoll wrote of his conviction that the animal was a

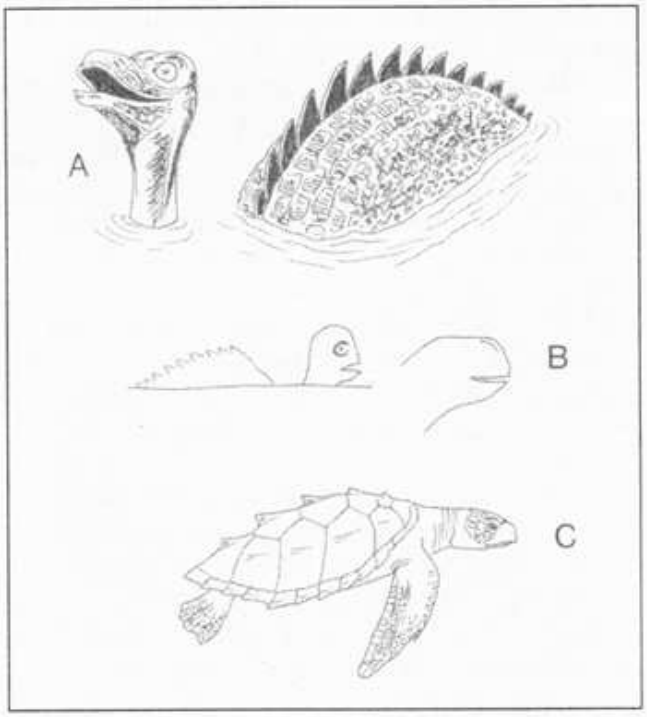


**Fig 1. a.** Creature reportedly seen in 1905 by Geddes and Gavin (from the *Illustrated London News*. **b.** Geddes and Gavin's original sketches (from Bright 1989). **c.** A Kemp's ridley (Lepidochelys kempii) with serrated dorsal midline.

mammal, but noted that he based this conclusion on the overall look of the animal and its soft, 'rubbery' dorsal fin. [19] Heuvelmans also noted that the size of the creature's mouth in Nicoll's sketch suggests a mammalian identity more than a reptilian one. [20] While neither of these arguments is convincing, similar animals with soft 'rubbery' fins and long necks were reported from Indochinese waters between 1897 and 1904 and by the *HMS Hilary* in 1917. While Ellis [21] has also suggested that the Val Halla animal might have been another giant squid, I am inclined to accept it and similar sightings as among the most compelling of aquatic cryptid accounts.

Many reported aquatic cryptid sightings are simply of rows of undulating humps: no head or neck is seen. Such descriptions do not in any way seem differentiable from oscillating waves that result from the actions of winds and boat wakes. These can appear solid and create the impression of a moving object, as I can vouch from personal observation. In view of this, Mackal [22] even went as far as discounting all reports of undulating humps.

Anecdotal evidence is hard to evaluate when it is contradictory. Among the many sightings reported from Loch Ness, perhaps the most fascinating are those that report the creatures on land. As noted by several authors, such reports might considerably augment our understanding of the biology of whatever species the Loch Ness animals represent – the problem is the lack of consistently in the reports. In 1932 Col and Mrs Fordyce reported a shaggy-furred camel-like animal that crossed the road to get to the loch; [23] Arthur Grant's 1934 report is of a long-necked plesiosaur-like seal (especially according to Costello [24]); Margaret Cameron's sighting from the early 1900s was of a quadrupedal elephantine beast that moved by 'humping' [25]; while the object reported in 1933 by the Spicers almost defies description (**Fig 2**). Are these different descriptions artefactual: the result of various people's attempts to acquaint their sighting with the animals most familiar to them, does it show that different people are misidentifying or misinterpreting various *different* Loch Ness animals, or does it show that we should simply disregard such reports? Given such problems, some workers might be inclined to pick those individual reports that most fit their own preconception or favoured theory. Such interpretative difficulties are inherent to cryptozoological investigations and urge caution in the evaluation of eyewitness testimony.

One approach to this problem has been to propose the existence of numerous separate species, such as the nine sea serpents suggested by Heuvelmans. [26] While it is evident that there are several species at the bottom of aquatic cryptid reports, the Heuvelmans scheme is plagued with problems and does not work when applied to specific reports [27] – as it surely should it if really was an accurate attempt at segmenting the data. It is further argued in this article that present data is thoroughly insufficient to come to conclusions as precise as those offered by Heuvelmans and certain of his followers.

If eyewitness data is problematical and often inconsistent, though at the same time compelling enough at times to demonstrate the presence of cryptids, photographic evidence is surely testable and less the subject of investigator interpretation. Unfortunately, photographic records of aquatic cryptids are scarce and those that exist are often fraudulent or of dire quality. Discussion of some of the existing photographic data is included in this article.

Carcasses reputed to be of aquatic cryptids represent the ultimate form of testable data – it only takes a visit from one experienced zoologist for the identity of the object to be scientifically tested. It is with frustrating regularity, however, that cryptozoologists write of the many lost chances in this area. While abundant alleged aquatic cryptid carcasses have been discovered on the shores of lakes and seas around the world, those that have not turned out to be of a known species (predominantly of sharks or cetaceans) have been lost. [28] A handful, including a Scottish carcass dealt with by council officer Charles Rankin in 1942 [29] and a Gambian carcass encountered in 1983 (discussed

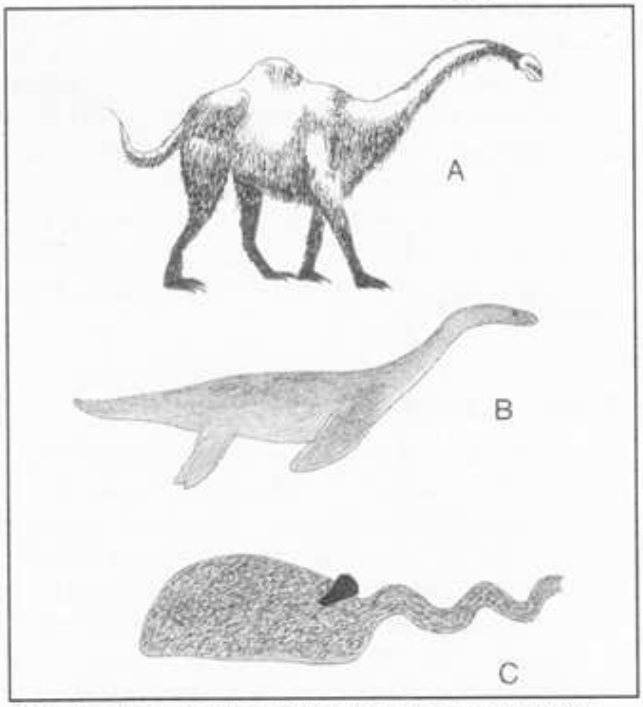


**Fig 2**. Assorted renditions of the Loch Ness monster when seen on land. **a**. The camel-like creature reported by Col and Mrs. Fordyce in 1932. **b**. Arthur Grant's 1934 plesiosaur-like seal. **c**. The creature reported by the Spicers in 1933.

below), are reported to be of known location and therefore, in theory, to be retrievable. Chorvinsky [30] noted that EL Wallace doubted the ziphiid identification of the 1925 Santa Cruz carcass, and implied that this case required further investigation. Examination of the good photographs taken of this carcass prove, beyond doubt, that the Santa Cruz carcass was of a Baird's fourtooth whale (*Berardius bairdii*) and none of the doubts raised about this identity have any serious standing.

In the absence of data that is not anecdotal, speculations in cryptozoology should be restrained. The not uncommon practise of erecting scientific names for cryptids is hardly a restrained activity and should be actively discouraged. All names created thus far for cryptids are *nomina nuda* as they lack type specimens: the ICZN mandates that type specimens must be actual specimens, [31] and not representations (photos or diagrams) of them. Heuvelmans [32] regarded this strict rule as a 'paralysing blow' and, apparently thinking that the creation of *nomina nuda* for the theoretical creatures he proposed would prove expedient to their official acceptance, named the aquatic cryptids *Hyperhydra egedei, Plurigibbosus novaeangliae, Cetioscolopendra aeliani, Megalotaria longicollis* and *Halshippus olaimagni*. [33] Scott and Rines [34] followed with *Nessiteras rhombopteryx* (regarded as probably congeneric with *Megalotaria* by Heuvelmans) and Bousfield and LeBlond have created *Cadborosaurus willsi*. [35] It could be argued that these names be regarded as provisional suggestions that remain as *nomina nuda* until type specimens are obtained (assuming for a moment that these creatures truly exist). On the other hand, they can also be regarded as imaginary names created for fictional entities. In that they have received widespread derision from many zoologists (*Cadborosaurus* in particular has been widely criticised [informally] by palaeontologists), they have hardly helped improve the understanding most non-cryptozoologists have of cryptozoology.

## A rash approach to identification

Bringing to mind Emiliano Aguirre's quote 'Let us not classify it before we find it' [36], cryptozoological writers have resurrected virtually every conceivable group of fossil vertebrate. These include innumerable reptilian taxa from the Mesozoic (eg, plesiosaurs, mosasaurs, dinosaurs, pterosaurs), archaic mammals from the Palaeogene and Neogene (basal proboscideans, archaeocete whales, chalicotheres, toxodonts) and an assortment of Pleistocene megafauna (eg, mammoths, machairodontine cats, thylacoleonids, teratorns). [37] If anything is clear from this long list of postulated prehistoric survivors, it is that, as portrayed in popular literature, cryptozoology is a flimsy area of whimsical speculation. While it is clear that these identifications are suggested, rather than explicitly stated, consideration of the idea that they might all survive to the present does not bring credence to cryptozoology as a science and provides fodder for creationism, the very antithesis of science.

Notably, such ideas have hardly ever been subjected to peer review, nor published in a formal scientific framework. As discussed further in this article, they are mostly misguided interpretations of data that essentially require the rejection of all testable models proposed for the evolution, geological distribution and extinction of fossil taxa. Importantly, cryptozoologists frequently display astounding naivety with regard to their knowledge of historical zoology. For example, Heuvelmans referred to palaeontology as an "archaic or obsolete science" [38] and wrote that lissamphibians and non-avian reptiles should be considered "living fossils" because "there are now relatively few survivors of these once-flourishing groups." [39] The latter assertion is particularly remarkable, as there are more extant non-avian reptile species than there are extant mammal species. More importantly, those who actually work on fossil groups, and are consequently well versed in the palaeoecology, geological distribution and systematics of these groups, hardly ever, in fact usually never, favour these scenarios. However, recalling Coleman's comment that many of those opposed to cryptozoology have in fact never read any of the cryptozoological literature, [40] most palæontologists are completely unaware that survival to the present has been suggested for many of the groups that they work on.

In discussion on the internet, Karl Shuker and I disagreed over how far researchers should go in proposing an identity for a given cryptid. I maintain that it is not at all unscientific to conclude that an answer is elusive, or indeterminable based on the available data. Sufficient data is plainly not at hand in allowing us to be at all confident about the identities of many cryptids – aquatic, long-necked and serpentine beasts included – and because some published hypotheses about their identities are unsatisfactory, such creatures are currently relegated to Vertebrata *incertae sedis*. That present knowledge and available data does not allow cryptid X, whatever it may be, to be assigned to a known group does not mean that an unlikely option should be the next most likely option. I find this scenario analogous to that discussed for fossils by Good. [41] Good tested how valid the referral of various squamate reptile fossil fragments to the group Gerrhonotinae actually was. Good stated:

> Placement of either paleontological [*sic*] or neontological material into taxa through mere similarity to known groups

and without sound phylogenetic evidence has been a common practise... There has been a tendency in the past among those working with fragmentary material to identity specimens to the same taxonomic level possible among more complete forms. However, it cannot be denied that fragmentary material often does not contain as much information, and it must be realized that there is nothing wrong with classifying only to the level of genus or family or even class, if there is insufficient information available to do otherwise.

Good ended his text with...

I propose that works describing and naming fragmentary material will be greatly improved if an attempt is first made to demonstrate that the materials have the diagnostic features of the groups to which they are referred.

Good's quotes are not exactly comparable with the nature of cryptozoological data, but I find the similarities more than cursory. Application of his logic might allow the following deduction: plesiosaurs are a group of sauropterygian reptiles characterised by subcentral foramina, two pairs of wing-shaped limbs, and a unique cranial architecture where the internal choanae are rostral to the external nares. The limitations of cryptozoological data mean that it is perhaps difficult, to say the least, to observe these features in extant long-necked cryptids and "...it must be realised that there is nothing wrong with classifying a specimen only to the level of genus or family or even class, if there is insufficient information available to do otherwise." With the cryptids, there is clearly insufficient information with which to allocate precise taxonomic identification. In this context, I regard a suggested identification as 'plesiosaur' far too precise. In conclusion, it is far more parsimonious, and scientific, to state that an identity is truly indeterminable based on present data. This is the case for most aquatic cryptids.

## Historical contingency

An important but largely unrecognised influence on the nature of cryptozoological speculations is that suggested identifications are, firstly, restricted to those taxa represented in the popular literature and, secondly, based on a historical framework of earlier identifications that were themselves erroneous because they were based on outdated interpretations. This notion of historical contingency was discussed previously **[42]** where it was argued that the idea of cryptozoic long-necked seals, a theory that is not dependent on an original historic context, actually fits the data better than does the idea that long-necked aquatic cryptids might be extant plesiosaurs. The latter theory is strongly dependent on the original historic framework in which it was proposed – that is, on the view of plesiosaur biology and lifestyle prevalent at the time (the 19th century).

## A RESTRICTED CHOICE OF TAXA

A detailed case of taxonomic restriction in a cryptozoological analysis is provided by Shuker's consideration of which fossil taxa might be likely candidates for the identity of 'Gambo', the Gambian sea serpent (*see below*). Shuker **[43]** considered thunniform ichthyosaurs, mosasaurs, thalattosuchian crocodyliforms, pliosauroid plesiosaurs and basal cetaceans ('archaeocetes'). While none of these groups provided taxa which, in their restored appearance, corresponded precisely with 'Gambo', Shuker concluded that the closest similarities were with pliosauroids and thalattosuchians. However, several other groups even more like Burnham's sketches are also known from the fossil record **(Fig 3)**, yet have never been mentioned in connection with this account.

**Shastasaurs** were a group of long-tailed Triassic ichthyosaurs best known from Nevada (*Shonisaurus* and *Cymbospondylus*). They are also known from Italy, Switzerland, British Columbia, Mexico, New Zealand

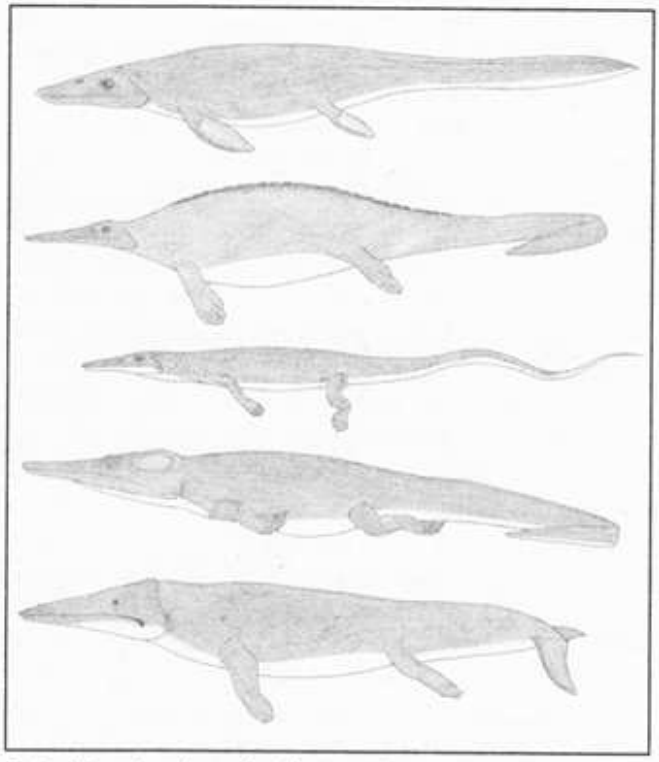

**Fig 3.** Life restorations of extinct aquatic vertebrates never considered within a cryptozoological framework, even though they are more like certain reported cryptids than other postulated prehistoric survivors. From top to bottom, the shastasaur *Cymbospondylus*, the hupehsuchian *Hupehsuchus*, the thalattosaur *Askeptosaurus*, the choristodere *Champsosaurus* and the remingtonocetid *Remingtonocetus*. Not drawn to scale.

and elsewhere. Recent work by Motani [44] indicates that the Shastasauridae as traditionally recognised is polyphyletic: the term shastasaur is used here for an informal group containing *Cymbospondylus* and Motani's Shastasauria. Ranging from about three to more than 12 metres in length, shastasaurs had elongate, robust rostra, two pairs of flipper-shaped limbs and, in contrast to thunniform Jurassic and Cretaceous ichthyosaurs, rather straight tails that were either without a distal expansion, or had a gently downturned distal tail tip with a low caudal fin. [45] Shastasaur skin impressions are unknown, but it is assumed that they were like other ichthyosaurs: these have a smooth, scaleless skin surface. While (like most ichthysaurs) most shastasaurs had huge eyes, in Cymbspondylus the location of the sclerotic ring within the orbit shows that the eye was proportionally small and restricted to the rostral half of the orbit. [46] The external nostrils in shastasaurs are located fairly close to the orbits.

**Hupehsuchians** were unusual long-jawed toothless Triassic reptiles with streamlined bodies, elongate tails and two pairs of paddle-shaped limbs. They are presently known only from China but were probably widespread. Reaching two metres in length, their external nostrils were located fairly close to their large orbits. The function of their long, toothless jaws has been the subject of some speculation: Carroll and Dong [47] suggested that they housed a baleen-like structure and that hupehsuchians were filter-feeders. This is unlikely and without evidence and Lee [48] has more recently suggested that hupehsuchians had beaked jaws. Curiously, hupehsuchians had a row of dorsal armour scutes that may have been antecedent to the internal neural structures seen in some juvenile ichthyosaurs. [49] Indeed, recent studies indicate that hupehsuchians are very close relatives of ancestral ichthyosaurs.

**Thalattosaurs** were another group of elongate, long-tailed Triassic marine reptiles. Best known from the Middle Triassic of Europe (*Askeptosaurus, Clarazia* and *Hescheleria*) and the Upper Triassic of California (*Thalattosaurus* and *Nectosaurus*), they are also present in British Columbia and elsewhere. [50] The Chinese form *Hanosaurus* was originally described as a thalattosaur but this is controversial. Thalattosaur bodies are long and all four limbs are paddle-like. Their bodies were unarmoured but their skin topography is otherwise unknown. Their nostrils were located about midway along their moderately elongate snouts and their eyes were not particularly large.

**Choristoderes** were crocodile-shaped amphibious or aquatic reptiles, reaching two metres in length, that are now known to have lived from Triassic to Eocene times (discussed further below). An Oligocene semi-terrestrial form from France, *Lazarussuchus*, was originally regarded as a late-surviving primitive choristodere but has recently been interpreted as a relative of the group rather than as a true choristodere. [51] Though long known only from the Upper Cretaceous-Palaeogene North American and European forms *Champsosaurus* and *Simoedosaurus*, Lower and Mid Cretaceous forms from Asia and Triassic and Jurassic European forms have extended the range and geological duration of the group. Indeed, Evans and Manabe [52] recently wrote "[Our] perception of the group has changed substantially, from that of a rather small group of very similar aquatic reptiles with a short temporal range, to that of a long lived, geographically widespread group, showing considerable size variation but, apparently, only limited morphological diversity." The diminutive Japanese form *Shokawa* challenges this idea of morphological conservatism in being long necked. Like crocodiles, choristoderes had terminal nostrils and an elongate rostrum.

**Remingtonocetids** were a bizarre group of long-skulled basal cetaceans from the Eocene of southern Asia. Unlike modern cetaceans, in remingtonocetids the nostrils were not located near the cranial vertex but were positioned relatively near the tip of the snout. [53] Their eyes were particularly small while the middle ears were large and the basicranium wide, suggesting an enhanced sense of directional hearing. Total length was probably between one (for *Attockicetus*) and four (for *Remingtonocetus* and *Dalanistes*) metres. Remingtonocetid postcrania is poorly known and largely undescribed but their hindlimbs appear to have been large and, as in otariids, available for use as hydrofoils and as supports for terrestrial locomotion. [54] It is inferred that, like the other larger protocetoids, they were rather seal-like in demeanour, though perhaps with an early form of the bilobed fluked tail. Though remingtonocetids were first described as ancestral odontocetes, they are now regarded as part of the Palaeocene-Eocene protocetoid radiation (**Fig 4**). They appear to represent a morphologically divergent branch, possibly evolving from basal protocetid protocetoids, that did not give rise to any descendants.

Shuker evaluated the merits of the various taxa he considered by scoring them against a list of features reported to have been present in the 'Gambo' carcass. By scoring shastasaurs, hupehsuchians, thalattosaurs, choristoderes and remingtonocetids against the same criteria, I found them to be have scores equal to or greater than those awarded to pliosauroids and thalattosuchians. The fundamental criticism lacking from this evaluation is the geological duration of the taxa involved and a critical assessment of their survivorship potential. However, while the new groups discussed here are inherently unlikely candidates for 'Gambo's' identity (as

are thalattosuchians and pliosauroids), the point is that they have not been considered in a cryptozoological framework because they are not well known in the popular literature. To my knowledge, thalattosaurs have only been depicted in the popular literature a handful of times. [55] I can only think of one published popular hupehsuchian rendition [56] and I cannot recall ever seeing a restored remingtonocetid in a non-technical book. Cryptozoological speculations may therefore be inherently constrained by lack of familiarity with fossil taxa.

## CHOICES BASED ON OUTDATED VIEWS

A second problem is that 'survivorship' scenarios pend on outdated views of the life appearances of fossil taxa, again because such views are prevalent in most of the traditional popular literature. There are many classic examples of this including those provided by cryptozoological discussions about surviving moa, mosasaurs (*see below*), pterosaurs, and teratorns. Two case studies, hadrosaur and sauropod dinosaurs, are discussed here.

**Hadrosaurs**, a group of Cretaceous ornithopod dinsaurs, are universally regarded today as predominantly terresrial in habit. This is evident from the morphology of their short-toed feet, stiffened tails, slim forelimbs, and teeth and jaws suited for the trituration of tough terrestrial foliage. [57] An older view, based on the idea that hadrosaur teeth were weak, is that hadrosaurs were amphibious or aquatic. It seems unlikely that hadrosaurs swam to escape predatory theropod dinosaurs – it is clear from a cursory examination of their skeletons that theropods would have easily outswam hadrosaurs if the latter were to retreat into water, as was argued by Paul. [58] It should be noted that Horner contends that *Gryposaurus* may, alone among hadrosaurs, have been amphibious. [59] His evidence for this – the presence of cranial kinesis and a serrated beak margin in *Gryposaurus* which he compares to that of filter-feeding ducks – is erroneous: all hadrosaurs (and all iguanodontian ornithopods) exhibit cranial kinesis and ducks feed using buccal lamellae. Despite this consensus in the palaeontological community, as recently as 1997, Coleman [60] suggested that Native American legends about horned water serpents could pertain to crested hadrosaurs, seeing as, Coleman argued, certain hadrosaurs (like the water serpents) had horn-like cranial crests and were amphibious or aquatic.

Fig 4. Phylogram depicting the interrelationships of basal cetaceans. **a.** **Pakicetids** were dog-sized amphibious mesonychians that probably foraged and swam in shallow waters. **b.** **Ambulocetids** may have been crocodile-like ambush predators and had sprawling limbs. **c.** **Remingtonocetids** were long-snouted aberrant forms. **d.** **Protocetids** were seal-like and pelagic. **e.** Later whales, including basilosaurids and **dorudontids** (shown here), were fully aquatic and with reduced or absent hindlimbs.

**Sauropods** Similarly, the modern conception of the mokele-mbembe as a swamp-dwelling amphibious sauropod owes itself entirely to outdated restorations of sauropods as hippo-like swamp-dwellers, supposedly well adapted for life in marshy environments. Regardless of the merits of a sauropod identity for mokele-mbembe, it is clear that the cryptozoological conception of this cryptid as a marsh-dwelling amphibious animal stems from the artistic restorations of these animals prevalent in the 1950s and earlier. Indeed Heuvelmans [61] even figured art by Zdenûk Burian – the ultimate iconographic representation of this view of sauropods. Whether mokele-mbembe is or is not a sauropod, the point is that, if those researchers who favour a sauropod identity for mokele-mbembe had been immersed in literature and iconography where sauropods were depicted as terrestrial, dry-land animals, [62] there would not be such a strong historical bias towards a sauropod identity for this cryptid. From the point of view of a contemporary palaeontologist, the cryptozoological view of the mokele-mbembe is a cultural anachronism, not a zoological one and, accordingly, I and other modern palaeontologists have great difficulty in imagining that the mokele-mbembe could be a sauropod.

When considering that fossil taxa might be the possible identities behind accounts of cryptids, cryptozoologists should acquaint themselves with up-to-date data on the life appearances and probable life habits of the

fossil animals involved. Failing this, it is they, not the cryptids, which are the anachronisms.

### Ghosts, gaps and Lazarus taxa

A ghost lineage, put simply, is a lineage currently thought to have existed (as determined by analysis of a group's evolution), but not as yet supported by the presence of fossils. As an example, genetic and morphological data indicate that chimps and humans share an ancestor. However, no fossil chimps or proto-chimps are known, whereas humans first appear in the fossil record 4.4 million years ago (as *Ardipithecus* [or *Australopithecus*] *ramidus*). [63] Therefore, the chimp lineage must extend back this far as well, but because this lineage presently lacks fossils to support it, it is known as a ghost lineage.

A great deal of recent research has focused on the occurrence and duration of ghost lineages in the fossil record, predominantly as a consequence of the cladistic paradigm. Cladistics is a way of analysing the affinities of organisms by collecting data on their morphological, genetic, ecological and/or behavioural features, determining by comparison which of these are inherited from ancestors – 'primitive characters' – and which have arisen more recently – 'derived characters' – and then hypothesising a branching sequence in the evolution of the group. Cladistic analysis, while not permitting the recognition of direct ancestor-descendant relationships, has allowed us to improve our understanding of the branching sequences within groups.

As the distribution within time of taxa is irrelevant to cladistic analysis, the branching patterns that may be revealed are not necessarily in agreement with stratigraphic distribution (though they usually are). Some key groups (discussed here) therefore reveal very long ghost lineages: in other words, large chunks that are missing from their fossil records. If Mesozoic and early Cainozoic vertebrates (eg, sauropods, plesiosaurs, basilosaurid whales) truly have survived to the present, they similarly must also have long ghost lineages. Here it is discussed if this is probable given what we known about the ghost lineages recognised for other groups, and given what we know about the quality of the fossil record.

## TAXA WITH LONG GHOST LINEAGES

**Thescelosaurids** An astounding ghost lineage of around 105 million years (that is, more than 1.5 times longer than the whole of the Cainozoic Era) has been documented for the thescelosaurids, a group of ornithopod dinosaurs. Though known only from the latest Cretaceous, thescelosaurids appear to have diverged from related forms during the Early Jurassic, about 170 million years ago. [64] While this article was in preparation, however, a possible Jurassic thescelosaurid was reported. [65]

**Choristoderes** were crocodile-shaped amphibious reptiles with slim, elongate snouts (*see above*). First described from the late Cretaceous rocks of Montana in 1876, they were later found in rocks of the early Cainozoic, thereby proving that the group had survived across the KT boundary. Their geological range was not of a particularly significant length. However, in 1989 Evans described choristodere fossils from the Bathonian, pulling the fossil record of these reptiles way back and showing that they had a lengthy Mid Jurassic-Late Cretaceous ghost lineage. Even more remarkably, and overlooked until reanalysis by Storrs and Gower, [66] though it was described as a choristodere by von Huene in 1935, is that a Late Triassic fossil – *Pachystropheus* – also seems to be a choristodere. This extends the choristodere fossil record backwards another 45 million years. In 1992, Hecht described a choristodere from the Oligocene. [67] In recognition of the idea of Lazarus taxa (a term analogous to 'living fossils'), he named it *Lazarussuchus*. Amazingly, cladistic analysis of all choristoderes [68] indicates that *Lazarussuchus* is actually very primitive, more so than Cretaceous choristoderes, so it represents a ghost lineage extending back from the Oligocene to, at least, the Cretaceous. *Lazarussuchus* has recently been excluded from the Choristodera by Gao and Fox. [69] Why choristoderes are so good at phasing in and out of the fossil record is unclear.

## ANACHRONISTIC CRYPTIDS IN THE LIGHT OF KNOWN GHOST LINEAGES

The implications that studies on ghost lineages have on the identities that have been proposed for cryptids are wide ranging. Firstly, the cryptozoological scenarios, if viable, would show that ghost lineages for vertebrates are more widespread than previously recognised, if not ubiquitous given that cryptozoologists have proposed the survival of virtually every major group of extinct vertebrate. Secondly, if ghost lineages are more abundant that previously thought, the quality of the vertebrate fossil record is poorer than estimated and the fossil record is utterly unreliable in recording mass extinction events and the true durations of lineages.

While it is true that many fossil species and genera await description and discovery, it is notable, and statistically significant, that increasingly fewer new taxa significantly extend the geological durations of lineages. While Weishampel [70] noted that new discoveries could increase patchiness in the fossil record (as is the

case with temnospondyls) [71] and Storrs and Gower [72] wondered if the patchiness of the choristodere fossil record implied that aquatic reptiles might have longer lineage durations than those revealed by their fossil records, it is important that the fossil taxa most often regarded as potential prehistoric survivors are those groups with the best fossil records. Sauropterygians for example (the group that includes plesiosaurs), have a continuous and detectable fossil record (even when they were apparently rare due to mass extinction events) for virtually the whole of the Mesozoic. [73] Benton and Storrs [74] estimated, based on branching patterns indicated by cladistic analysis, that this record was 94.4% complete. While new plesiosaur taxa continue to be discovered, all come from parts of geological time already known to have been inhabited by plesiosaurs. The same could be said for sauropods, pterosaurs, basal cetaceans and other groups. Furthermore, while the overall quality of the fossil record is often questioned, palaeontologists that actually work on this problem find the fossil record to be a trustworthy documentation of ancient life. [75]

Rather, therefore, than accept radical alterations to our understanding of the fossil record, the diversity and duration of vertebrate lineages, and the events and transitions in the geological record – without any data other than spurious interpretations of eyewitness reports – it seems more likely that virtually all of the proposed instances of survivorship can be discounted.

## RED HERRINGS

Some extant groups of aquatic vertebrate might offer hope to those who argue for the survival of Mesozoic and early Cainozoic taxa. Supposedly, these groups have ghost lineages comparable to those for hypothetical extant Mesozoic and early Cainozoic taxa. As argued previously, [76] this is not the case.

**Megamouth sharks** were first documented by science in 1976 when the holotype specimen of *Megachasma pelagios* was retrieved. Since then the species has been documented from diverse locations in the Pacific and Atlantic. Fossil megachasmids have been recognised in Miocene rocks of California and from the Eocene of England and Argentina. [77] That large chondrichthyan taxa may be rare in the fossil record is predictable seeing as they have a predominantly tooth-based fossil record. For this reason they are not comparable with reptiles, like plesiosaurs, or mammals, like archaeocete cetaceans. The deepwater lifestyle and diminutive teeth of megachasmids also mean that their fossil record is hardly comparable with that of *Carcharocles* (or *Carcharodon*) *megalodon*, a species that shed numerous of its huge teeth on the shallow continental seafloors of the world while it was extant. I agree with Roesch regarding the potential survival to the present of this gigantic shark. [78] The supposed cases often cited in support of *C. megalodon* 'survival' are both highly unreliable and strikingly few in number. As a coastal, mammal-eating predator of the continental shelf, the idea that *C. megalodon* might be alive is ludicrous and can be safely dismissed.

**Coelacanths** have frequently been employed as probable verification for the idea that Cretaceous taxa can survive, undetected in the fossil record, into modern times. This view is appealing, and has even been employed by palæontologists when considering the possible survival of fossil taxa. [79] However, it totally fails to take into account firstly, the lack of similarity between a group of medium-sized fishes with mostly enormous, pelagic air-breathing reptiles and, secondly, the peculiarities of the cœlacanth fossil record. While plesiosaurs and some other marine reptiles were present at high taxonomic diversity in the Maastrichtian and then suffered a devastating mass extinction event, cœlacanths trickle out slowly from the Upper Cretaceous fossil record and are present at low generic diversity throughout this time and throughout the Cainozoic. Not only are cœlacanths represented in the extant fauna as several populations, fossils of Cainozoic cœlacanths have also been reported from the Palaeocene of Sweden and the Miocene of Israel. [80] Consequently, cœlacanths have been dubbed 'red herrings' in what they might tell us about the survivability potential of Cretaceous marine vertebrates. [81]

The alternative interpretation of this evidence is that post-Cretaceous fossils of plesiosaurs and other Mesozoic taxa may similarly await discovery: that palaeontology has taken so long to discover Cainozoic cœlacanth fossils is encouraging in that it makes the discovery of Cainozoic plesiosaur fossils somewhat less improbable. [82] I find it hard to agree with this interpretation – unlike cœlacanths, plesiosaurs and other supposed Mesozoic 'survivors' were large animals with large, dense, resistant and highly diagnostic skeletal elements (the dumb-bell-shaped phalanges and distinctive vertebrae of plesiosaurs are unique). Fara and Benton [83] also recently addressed the suggestion that certain lineages are missing from parts of the fossil record because their fossils are preserved in relatively unsampled areas. They concluded: "[The] appeal to unexplored regions is exactly the argument used in the 1750s to deny the possibility of extinction." [84] If plesiosaurs and other fossil taxa were present in the Cainozoic fossil record, it would surely be more logical to expect their remains to be discovered before those of Cainozoic cœlacanths. This has not happened. None of the ghost lineages apparent in the vertebrate fossil record offer

any support for the idea that large Mesozoic or early Cainozoic marine vertebrates might have survived undetected to the present.

## The likelihood of prehistoric survivorship

Based on analysis of the fossil record and the lifestyles and morphologies of the taxa under consideration, we can make a series of predictions as to how likely proposed scenarios of survivorship are. Because they are controlled by the limitations of historical contingency, as demonstrated above, few survivorship scenarios imagine the cryptids to resemble the fossil taxa they supposedly descent from. An extreme example is the armour-plated basal cetacean *Cetioscolopendra* [85] but swan-necked plesiosaurs, snake-like basilosaurids and vulturine teratorns provide less ridiculous examples. The argument against dismissing these as out of line with palaeontological evidence is that modern-day representatives of groups known only as fossils might well be different, in their morphology, physiology and behaviour, from their fossil relatives. [86] While this idea has some logic, it essentially eschews from any attempt to permit testability of the models it proposes, and is therefore inherently unscientific. If any comments are to be made on the proposed survivorship of fossil taxa – clearly preferable if cryptozoology is to benefit from critical thinking – then comparisons must be made with what we know of the fossils involved.

**Marine crocodiles** At various times it has been suggested that metriorhynchid thalattosuchians may account for some cryptid accounts. This proposal is extraordinarily implausible. Marine crocodiles are like other marine tetrapods in having a good fossil record, and in being preceded and superseded in the geological record by ecological analogues. That metriorhynchids, the most marine of the thalattosuchians (and, indeed, of all crocodyliforms), are not present post-Barremian (Lower Cretaceous) shows that they did not survive into the Upper Cretaceous. [87] Dyrosaurids, pholidosaurids and some of the nearshore mosasaurs all took the place of metriorhynchids in the Upper Cretaceous: in the early Cainozoic thoracosaurine crocodylids and archaeocetes took over the role of nearshore predator. No reported cryptid has any close resemblance to any fossil metriorhynchid, including the 1983 Gambian carcass (*see below*). Metriorhynchids are known from specimens that preserve their entire body outline – these show that the animals had bizarre tiny forelimbs and enlarged, wing-like hindlimbs. [88]

Freeman recently suggested that some marine crocodile-like cryptids might actually have been very large *Crocodylus* crocodiles. [89] Freeman suggested that exceptionally large crocodiles may become both effective gigantotherms and specialised mariners: they might then be able to travel to places well away from their tropical homes and to cool latitudes. *C. porosus* certainly is a superb mariner – authenticated sightings of individuals have been reported from the Cocos Islands and only 40 km from North Cape, New Zealand. Also, recent investigations on *C. porosus* physiology show that large individuals are effective gigantotherms. [90] It seems probable, however, that gigantothermy in crocodiles pends on high ambient temperatures and Freeman's scenario is both improbable and based on too few reports to deserve serious consideration.

**Mosasaurs.** Mostly enormous marine lizards from the Cretaceous (three to 15 metres long), mosasaurs have been regarded as the potential identity behind cryptids on several occasions, including as the possible true identity of the migo, an alleged cryptid from Lake Dakataua, New Britain [91] (*see below*). Mosasaur bodies were elongate and laterally flexible, they had vaguely crocodile-like heads, and they had four paddle-like limbs. The primary reason for regarding certain cryptids as mosasaurs proves to be entirely erroneous. Because, in popular artwork (eg, that by Charles Knight, Zdenûk Burian, John Sibbick), mosasaurs have nearly always been restored with a wavy dermal frill growing along the top of the back and tail, cryptozoologists had therefore made direct comparisons between these images and reported cryptids. As determined by Williston in 1902, [92] the first and only report of a wavy crest in a mosasaur was an error – preserved cartilage rings from the trachea had actually been mistaken for spines from a dermal crest. The imagined survival of mosasaurs to the present is, therefore, an extreme example of reliance on outdated imagery (*see above*).

**Archaeocetes** are a paraphyletic assemblage of primitive whales that range from dog-sized amphibious pakicetid protocetoids to the bizarre long-snouted remingtonocetids, the gigantic, long-bodied basilosaurids and the dorudontids, the probable ancestors of later whales. The archaeocete radiation has proved diverse with numerous lineages experimenting with different lifestyles and morphologies. While archaeocetes, in the general sense, survive today as extant whales, in the specific sense two groups, protocetid protocetoids and basilosaurids, have been regarded as potential prehistoric survivors by some cryptozoological authors. Heuvelmans [93] argued that his 'super otter' (*Hyperhydra egedei*) was an extant protocetoid, apparently because he regarded *Hyperhydra* as a cetacean, but one that possessed four limbs. Besides the palaeontological problems with this idea, there are several methodological issues. [94] Combine these with a lack of any good 'super otter' reports, and the fact that Heuvelmans regarded *Hyperhydra* as extinct in any

case, and the creature is non existent. Even Shuker [95] does not favour the idea of surviving protocetoids, suggesting instead that, because it is now known that Eocene basilosaurids possessed tiny hindlimbs, modern quadrupedal aquatic cryptids might be basilosaurids instead. The idea that the migo of Lake Dakataua might be a protocetoid is based on misidentification of delphinid cetaceans. [96]

Basilosaurids were enormous long-bodied cetaceans known from Late Eocene rocks of North America, Pakistan and Africa. [97] Importantly, they are only known from four species (*Basilosaurus isis, B. cetoides, B. drazindai* and *Basiloterus hussaini*) and were morphologically uniform and, with their bizarre elongated vertebrae, highly specialised. The idea that basilosaurids might have survived to the present is contradicted by their total disappearance at the end of the Eocene. Cryptids likened to basilosaurids are as large or larger than the fossil species, so if the group has survived for 36 million years longer than thought (again, an unprecedented ghost lineage for any group of large aquatic vertebrate), their fossils should be present somewhere. Suggested post-Eocene archaeocetes [98] if they are archæocetes, are certainly not basilosaurids. How basilosaurids looked and swam in life remains problematic: [99] it is likely that they could arch their bodies but they could not have thrown them into the loops and hoops reported for some cryptids. Such accounts probably refer to large eels. That basilosaurids were gigantic macropredators casts further doubt on the idea that they might have survived: after their disappearance their role is taken by large predatory platanistoid odontocetes; in turn these are replaced by physeteroids and delphinidans. Today physeteroid and diverse delphinidan odontocetes and sharks occupy the role of marine macropredator. Contrary to certain suggestions, [100] no archaeocete worker thinks that basilosaurids survived beyond the Eocene. If long-bodied cetaceans do exist today, as suggested by B Clark's encounter in Lake Okanagan, they are more likely to be delphinidans. Corroborating evidence for Clark's belief that the animal was a whale is presently absent.

**Plesiosaurs**. Given that aquatic cryptids are often reported as long-necked and reptilian in demeanour, it has long been tempting for cryptozoologists to speculate that long-necked plesiosaurs may actually have survived their apparent extinction at the end of the Maastrichtian stage of the Upper Cretaceous. Plesiosaurs somewhat fell out of favour as Heuvelmans and other writers favoured a long-necked seal identity for long-necked cryptids. Indeed, extant plesiosaurs are tremendously unlikely aquatic cryptid identities compared to these hypothetical long-necked pinnipeds. While bringing plesiosaurs 'back to life' would create a 65-million-year ghost lineage, long-necked cryptids are also reported to be furry, to have whiskers, and to have soft tissue humps. They therefore sound more like mammals than reptiles. The detailed morphology of the eyes, ears and necks of plesiosaurs suggest that they were not in the habit of moving their necks vertically, or sensing things in the air. [101] Obviously such objections can be regarded as conjectural, as are assertions that plesiosaurs could probably not move on land (on account of their ventral limb girdles and lack of contact between the limb girdles and vertebral column).

That long-necked pinnipeds were entirely theoretical, however, has meant that the existence of such creatures was arguably less probable that the survival of forms at least known as fossils. It is therefore surprising that the long-necked Pliocene pinniped *Acrophoca longirostris*, though described in 1981, [102] was not brought to the attention of cryptozoologists earlier. *Acrophoca* is a lobodont phocid (probably related to Hydrurga) from South America. It has an elongate, slim skull, an elongate neck and has been described as being serpentiform in shape [103] (**Fig 5**). A new, currently undescribed fossil species of *Acrophoca* is even longer-skulled than *A. longirostris*. It is noteworthy here how reptilian and disturbing *Hydrurga* and some other large pinnipeds can appear: few people are familiar with the appearance of these animals.

A suggestion originally made by Miller [104] is that hypothetical extant plesiosaurs might not float or be stranded after death because their gastroliths (stomach

**Fig 5**. Life restoration of the long-necked phocid *Acrophoca longirostris*. *Acrophoca* is from the Pisco Formation of Peru.

stones) would make their carcasses sink. Supposedly, this might explain the rarity of plesiosaur carcasses on lake- and seashores today. However, that otariid and penguin carcasses (extant groups that are probably as pelagic as plesiosaurs and also possess gastroliths) are commonly stranded on modern beaches shows such a suggestion to be ill founded. More importantly, that plesiosaurs are so well represented in shallow water marine sediments throughout the Mesozoic Era indicates that gastrolith possession is merely an excuse for special pleading from some cryptozoological corners, not a reasonable explanation of a pattern.

That sauropterygians may have survived beyond the Cretaceous-Tertiary boundary to the present, and thereby be in possession of a 65 million year ghost lineage, is implausible because it is without precedent in the marine vertebrate fossil record (*see above*). Being large, predominantly aquatic tetrapods (with diagnostic skeletal elements) that lived and died in environments where preservation was likely and frequent, sauropterygians have a superb fossil record. While no satisfactory solution to the identity of long-necked aquatic cryptids is currently apparent, it appears more likely that the animals are long-necked pinnipeds than they are extant plesiosaurs.

**Ichthyosaurs.** Best known as tuna-shaped (thunniform) marine reptiles from the Jurassic and Cretaceous, ichthyosaurs are, in terms of their bony and soft tissue anatomy and aspects of their physiology and life history, arguably the best understood of Mesozoic reptiles. **[105]** Triassic ichthyosaurs, like the shastasaurs, were not thunniform but long-bodied with elongate sculling tails and four paddles. Despite their superbly hydrodynamic form and complete commitment to aquatic life, ichthyosaurs do not appear to have survived to the end of the Cretaceous and the youngest known fossils are from the Cenomanian (but see below). While theories about surviving plesiosaurs are familiar to all cryptozoological researchers, few are aware that the survival of ichthyosaurs has been posited on a number of occasions. Dinsdale **[106]** described cases where witnesses suggested that both cryptids and decomposing carcasses might have been of ichthyosaurs. Meurger and Gagnon **[107]** noted that some reports from Lake Saint-François, Quebec, reminded them of ichthyosaurs, but apparently only because the witnesses had likened the creatures they saw to large dolphin-like cetaceans. Sylvestre referred to work by Laenen in which the author attempted to show that cetaceans are actually descendants of ichthyosaurs. **[108]** This is about as supportable as the idea that mammals descended from annelids via moles and amphisbaenians, though nevertheless I find it interesting.

What is further interesting, in view of these suggestions, is that, like cœlacanths, ichthyosaurs appear to have clung on at low taxonomic diversity throughout a large part of the Cretaceous – while the last 'official' ichthyosaur is Cenomanian there are Santonian records and even an ichthyosaur from the Miocene. While this latter specimen is almost certainly reworked, this has not been demonstrated. In contrast to the fossil record of plesiosaurs and mosasaurs, therefore, ichthyosaurs could be argued to follow a 'cœlacanth pattern': surviving at very low taxonomic diversity for much of the Cretaceous and then throughout the Cainozoic and into the present. Obviously I do not propose this idea with any serious intent – the point is that it is the only potential survivorship case that might fit the pattern of geological evidence.

## EXTINCTIONS PRODUCE PATTERNS

Abundant evidence indicates that extinction events recorded in the geological record, such as those that ended the Cretaceous and Eocene periods, were devastating and entire groups of organisms – namely those that lived within certain ecological guilds, or those above a certain body size – became extinct. All Maastrichtian reptiles above one metre or so in body length, and this includes plesiosaurs, mosasaurs and most non-avian dinosaurs, died. No evidence indicates otherwise.

If, on the other hand, many or all of these groups survived, we have totally unexplainable patterns. No Maastrichtian plesiosaur or mosasaur was less than three metres long. If these animals survived, why didn't hesperornithiform birds or ammonites? In fact, with their air sacs, plumalaceous feathers, possible large size and elongate necks, hesperornithiforms are no more likely, and no more unlikely, than extant plesiosaurs. An imaginary extant hesperornithiform would also correspond closely to certain famous sea serpent drawings, such as that of the creature apparently netted by Reece and Gilbert in 1926 off the coast of Falmouth, Cornwall **[109]** **(Fig 6)**. That plesiosaurs are favoured over hesperornithiforms is, once again, an example of historical contingency.

### The testable data

Despite the criticisms mentioned and discussed above, and the insistence of sceptics of cryptozoology that hard data is needed to verify the many claims of cryptozoological writers, it is always worth arguing that there *is* testable data in the field of aquatic cryptids: eyewitness reports and some photographs. Eyewitness data is often hard to evaluate, as discussed earlier. Meanwhile, relatively few photographs of aquatic cryptids are available, and even fewer reveal enough information to be worthy of evaluation.

## COMMENTS ON EVIDENCE FROM LOCH NESS

Published evidence indicating the existence of a large cryptid in Loch Ness is problematical in that there is no convincing photographic data and difficulty surrounds interpretation of the many apparently compelling sonar traces. Of the photographic evidence, and ignoring those long acknowledged to be of dubious authenticity (eg, the Peter O'Conner, Frank Searl and Tony Shiels photos) or of great ambiguity (eg, the 1958 H Cockrell and 1934 FC Adams photos) it now seems that the 1934 Robert Wilson, 1951 Lachlan Stuart and 1955 Peter MacNab photographs are fakes. [110] This only leaves a handful of others, including Hugh Gray's 1933 unsatisfactory 'swimming labrador' photo. [111] Ripple size in the photo shows that this is not really a swimming labrador, but it remains unclear as to whether it depicts an animal. Of the underwater photos, the body and neck photo taken by the Rines team in 1975 is tantalising but indeterminate. The two flipper photos are perhaps the best piece of material evidence for the existence of large unknown animals in Loch Ness – they are either fakes, as suggested by Binns, [112] or they do belong to a large aquatic cryptid. Unfortunately it is impossible to determine the size of the objects – it seems improbable that they are as large as often suggested (two metres long or more).

One of the Rine's photos appears to depict a close-up shot of an animal's head with a series of horns on its dorsal surface. Dubbed the 'gargoyle' photo, Mackal [113] noted George Zug's suggestion that, because of its apparent bilateral symmetry, the object is not a log, but possibly an animal. Scott published an interpretation of the gargoyle head as a blunt-faced creature with a central nasal horn and two pairs of tubular horns above its eyes. [114] An obvious problem with making the gargoyle head the actual head of the Loch Ness animal is that hardly any eyewitness accounts from Loch Ness describe a head of this form. It appears most likely that this photo does not depict an animal but an object such as a tree stump and both Binns and Dash [115] specifically identified particular tree stumps, in the latter case one called 'Ralph', as the culprits behind the photo. Believing the 'gargoyle head' photo to represent the head of the Loch Ness animal, Witchell drew a parallel between the horns of the gargoyle head and the foramina seen in the skulls of fossil plesiosaurs. [116] Apart from the orbital and narial openings, the only foramina present in plesiosaur skulls are the supratemporal fenestrae. These are also seen in the skulls of many other reptiles, including living lizards and crocodiles, and probably function in stress dissipation and muscle attachment.

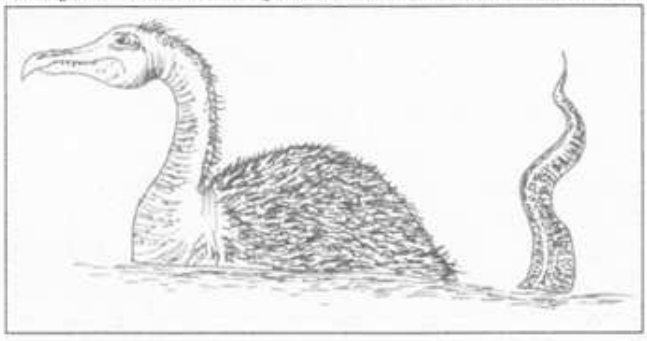

**Fig 6.** If plesiosaurs and other Mesozoic marine animals survived to the present why has this creature, reportedly caught by Reece and Gilbert in 1926, never been regarded as a surviving hesperornithiform?

## LAKE CHAMPLAIN – THE MANSI PHOTOGRAPH

Perhaps the most impressive aquatic cryptid photograph is the Mansi photograph, taken at Lake Champlain in July 1977 by Sandra Mansi. The photograph appears to depict a long-necked grey-brown animal that is curving its neck over its rounded back, as if it is looking behind itself. It looks rather like a traditional depiction of a sauropod though some writers have compared it with basilosaurid whales. [117] This is odd because all whales, including basilosaurids, have very short necks.

It is clear that the object in the Mansi photo is large, and that the neck and body are connected beneath the water surface. Image enhancement by the photographic expert Peter Suthers (shown in an edition of the 'Out of the Unknown' *Discovery* series) provides an interesting new perspective on the photo. By bleeding out the colours and thereby enhancing the shape of the object in the photo, Suthers revealed several previously unreported features. These were a group of amorphous black shapes to the left of the object, a sloping 'shoulder' on the left side of the base of the object's 'neck', and another 'shoulder' on the right side that joins the base of the neck with the body (**Fig 7**). Suthers interpreted these new features as vindication for the idea that the object does represent an animal. Bizarrely, Suthers went on to suggest that, rather than representing the body, neck and head of an animal, the object might instead be a bifid fluked tail. *Discovery* elaborated on this suggestion by drawing the outline of a cetacean-like tail onto the object in the Mansi photo, thereby endorsing their speculation that 'Champ' is an extant basilosaurid. It should be clear from examination of the photo that the object cannot possibly be a whale's tail.

Furthermore, rather than supporting the suggestion that the Mansi object was an unknown animal, these findings call such an identification into question. The new profile of the object provided by Suthers indicates

that the object is less like an animal than perceived before: the left-side 'shoulder' makes no sense anatomically and completely ruins the plesiosaur-like profile of the object while the shapes on the left defy explanation. I suggest that the object is a large mass of wood with a neck-shaped branch: according to Mansi's testimony, this momentarily burst through the water surface before turning and sinking.

## CADBOROSAURUS CARCASS PHOTOGRAPHS

People on and around the coasts of British Columbia have long reported an enigmatic, long-necked, serpentine animal whose existence has never been verified by science. This has popularly been dubbed 'Caddy' or 'Cadborosaurus' after Cadboro Bay, a sightings hotspot. In 1992 Bousfield and LeBlond announced a startling piece of evidence – three photos, taken on the flensing platform of a whaling station at Naden Harbour in the Queen Charlotte Islands, in 1937. Depicting an elongate object about three metres long that appears to have a camel-like head and a fluked tail, the photos apparently show a juvenile 'Caddy' carcass (from hereon dubbed the Naden Harbour Thing or NHT). Backed up by eyewitness reports that appear to describe the same animal (but in living form), Bousfield and LeBlond decided to formally name and describe this new animal, and in 1995 devoted Supplement 1 of the new journal *Amphipacifica* to their paper on *Cadborosaurus willsi*. [118] They proposed that *Cadborosaurus* might represent a surviving plesiosaur and made a number of speculations about its possible biology. [119]

While the number and quality of 'Caddy' eyewitness accounts suggest that there may indeed be a new species awaiting discovery in the region, Bousfield and LeBlond's proposal that the creature might be a living plesiosaur, and that such a species can be officially described and diagnosed based only on controversial photographic data, is highly problematical. Bauer and Russell [120] addressed many of these problems. Nevertheless, an immediate concern is: on what basis was the (tentative) plesiosaurian identity of *Cadborosaurus* arrived at? Bousfield and LeBlond pointed to similarities between the possible hindlimb of the NHT and those of several sauropterygians. Though their treatment of a pachypleurosaur as a nothosaur is an admittedly trivial problem, [121] the way in which they distorted and mislabelled a plesiosaur flipper was downright confusing. It was further implied that affinity is indicated by the similar hindlimb constructions of the figured sauropterygians and the NHT. This is thoroughly unconvincing, as all tetrapods have these same hindlimb elements. In any case, purported homology of the NHT's 'pseudo-fluke' with a tetrapod hindlimb is also unconvincing as a large dose of personal interpretation is required.

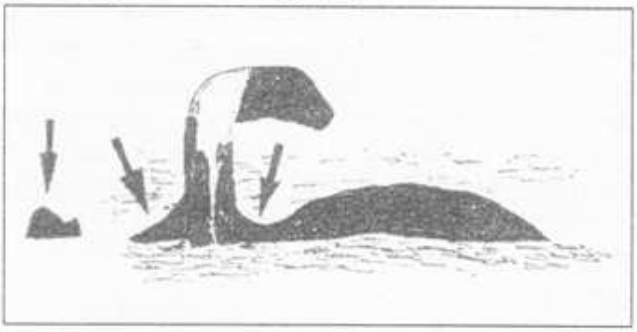

**Fig 7. a.** The Mansi photo, taken at Lake Champlain in 1981. **b.** Photographic enhancement reveals several areas/objects (marked here with arrows) that destroy the plesiosaur-like outline of this object.

While the object in the Naden Harbour photos appears at first sight to be a highly unusual, apparently new type of vertebrate animal, a series of British Columbian postcards issued in the 1930s depicted superficially similar objects. The best of these was taken on the rocky shoreline, within the littoral zone (barnacles are visible), at Camp Fircom, British Columbia. After close examination of this photo and others, I am convinced that they are not animal carcasses at all, but actually represent a montage of beach debris. [122] A second photo depicts the same assortment of debris, but arranged in a different posture and on a different part of the beach. While the Camp Fircom specimen is entirely detached from the NHT, the upshot is that some people in the 1930s were clearly in the habit of manufacturing fake 'Caddy' carcasses. Were they inspired by the NHT, or was it actually a product of this episode of trickery? The bizarre and problematic appearance of the NHT makes this option a possibility, and one that has to be considered (and, at best, discounted) before it can be assumed that the thing represents an animal. Ben Roesch also draws attention to the possibility that the NHT might be a shark carcass.

## 'GAMBO' – THE GAMBIAN SEA SERPENT

Evidence comparable to the NHT is a carcass allegedly examined by Owen Burnham in June 1983 at Bungalow Beach, Gambia. First reported in a letter to *BBC Wildlife*, Burnham's case has received publicity thanks to texts devoted to discussion of it by Bright and Shuker. [123] Burnham claims he knows exactly where this is buried: no excavation there has yet been carried out. Owen Burnham was not the sole witness of the Gambian carcass: it is documented that his father, sister and brother observed it as well. That their accounts tally with his (though I understand that they reported

somewhat differing measurements [G Inglis pers. comm. 1997]) does support authenticity of the account. However, I find it very difficult to believe that, as a competent naturalist, Burnham failed to take any kind of sample whatsoever. Clearly, Burnham could not be expected to pickle the carcass, or hack through it to pull out a potentially diagnostic organ or bone, but why did he not think to retain one piece of skin, a flipper, a tooth? Furthermore, no sketches drawn from the carcass, or photographs, exist. Burnham's several renditions of the creature were drawn on his return to the UK and not during his time in the Gambia. I bring attention to these points, not to attempt in any way to discredit Burnham or his report, but to illustrate the apocryphal and anecdotal nature of the account. As appealing as it is in potentially promising a bona fide sea serpent carcass, it is unfortunately no better than the many tales of lost sea serpent carcasses from the 18th and 19th centuries.

Burnham's description is essentially that of a small, short-necked plesiosaur, and he is adamant that it was not a whale. The only cetacean that might conform in some features to the Gambian carcass is *Tasmacetus shepherdi*, the poorly known Shepherd's or Tasman beaked whale, a species known from few specimens and only two probable sighting from the field. **[124]** Burnham discounted this species (and all other cetaceans) as the identity for the carcass and, though I feel based on Burnham's descriptions that this identification is not satisfactory, I note that some *Tasmacetus* carcasses do bear more than a passing resemblance to Burnham's drawings. Mead's photographs of a beached *Tasmacetus* specimen from Punta Buenos Aires **[125]** is superficially not unlike Burnham's drawings (**Fig 8**). In contrast to some artistic depictions of this species, these photos reveal an elongate, forceps-jawed rostrum, a poorly expressed melon, and prominent teeth along the lengths of the jaws. I also note some problems in Burnham's narrative. For example, he notes that no mammary glands were present, and that any external genitalia were 'too damaged to be recognisable'. However, the animal's underside could not be examined so it is not clear how these observations could have been made. Preliminary excavations in the approximate area of 'Gambo's' alleged burial have not been successful though, clearly, extensive excavations would be more satisfactory. **[126]**

## THE LAKE DAKATAUA FOOTAGE

In 1994 a Japanese film crew succeeded in filming a large animal swimming in the waters of Lake Dakataua on New Britain, supposedly the haunt of an aquatic creature called the migo or masali. Detailed investigation of this footage shows that it is of an Indopacific crocodile (*Crocodylus porosus*). **[127]** Suggestions that the film depicts two crocodiles engaged in mating (assuming that these suggestions pertain to the film I analysed) are completely incorrect – there is no doubt that the object in the footage is a single creature.

## THE LAKE VAN FOOTAGE

In October 1999 I was finally able to view the full length Lake Van footage. The video first shows Lake Van, and then a surfacing monster about four metres from the camera – it is an elongate shape with an irregular series of lumps along its length. It looks exceedingly like a log, and though it bobs up and down, there is no undulation and it appears stiff. The video then shows an elongate shape surging along the lake surface, briefly revealing a dorsal fin-like approximately triangular shape that creates a bow wave. The surging action is very odd, and I find it hard to imagine it being pulled off by a live animal – it looks much like an object being pulled along behind a boat. Finally, and most remarkably, there is a close-up shot of a pointed head with huge, oval eyes with vertical pupils. The whole head, including the eyes, is brown and looks decidedly 'woody'. A stream of bubbles breaks the water surface just in front of the tip of the 'snout'. I am confident that the head is carved out of wood, so therefore the bubbles must be coming out of an underwater hose or other contraption.

## Some conclusions, and where to go from here

Detailed familiarity with eyewitness reports, the relatively few reported carcasses and pieces of photographic evidence, the biology and comparative anatomy of extant and extinct animals, and the geological record of life on Earth permit a holistic approach to be taken to the mysterious identity of large aquatic cryptids.

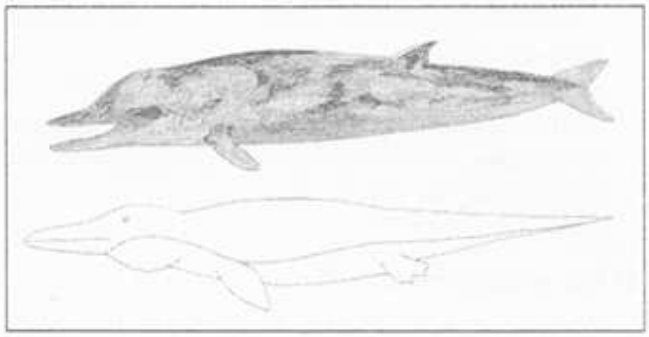

**Fig 8.** The decomposing carcass of a *Tasmacetus* specimen, based on photos of a South American specimen (from Mead 1989), compared with Burnham's rendition of 'Gambo'. There are superficial similarities.

I argue that there is nothing wrong in science with deciding that an answer cannot presently be reached, or is indeterminable based on the present data. After all, science is essentially the assessment of data in order to draw the most likely conclusion, and if a conclusion cannot be drawn, that is fine until more data comes along and allows further evaluation. What is so vexing with regard to the aquatic cryptid problem is that, even after more than two centuries of debate, we still appear no closer to the answer and good conclusive evidence is still not forthcoming. The priority of all researchers in this area should therefore be the collection of more data and the ultimate conclusion at present is something everyone can agree on: more data is needed. I draw the following conclusions from the discussion presented here.

1 Not all reports of aquatic cryptids represent unknown species and those that purport to require some testable data if we as scientists are to make conclusions based upon them.
2 The idea that fossil taxa from the Mesozoic or early Cainozoic have survived to the present day is, from a palæontological perspective, untenable. Coelacanths and megamouth sharks do not provide appropriate analogues for the imaginary survival of large-bodied fossil vertebrate taxa. This was even hinted at by Downes, today a harsh critic of conventional cryptozoological methodology, who wrote "One of the great fallacies of cryptozoology is that it is concerned with relict populations of ancient species when it is the emergent species which are of far greater interest." [128]
3 Hypothetical long-necked seals make better aquatic cryptid candidates than live plesiosaurs.
4 Existing photographic evidence is unfortunately not of sufficient quality to demonstrate the existence of aquatic cryptids, and those good quality photos that do exist are ambiguous. The discussion of photographic data presented here is obviously not intended to be comprehensive – such an undertaking would be a major undertaking but is recommended.
5 Hard data is needed if cryptozoological scenarios are to be accepted, workers should be sceptical rather than credulous and it is preferable to regard an issue as unanswerable based on current data than to propose an unlikely alternative.

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**121** Until recently pachypleurosaurs were regarded as only distantly related to true nothosaurs and could only be called nothosaurs if the term was used informally. Some newer studies, however, find that pachypleurosaurs are part of a monophyletic Nothosauria. For opposing views see: GW Storrs (1991). 'Anatomy and relationships of *Corosaurus alcovensis* (Diapsida: Sauropterygia) and the Triassic Alcova Limestone of Wyoming', *Bulletin of the Yale Univ. Peabody Museum of Natural History*, 44, pp1–151. O Rieppel (1998). '*Corosaurus alcovensis* Case and the interrelationships of Triassic stem-group Sauropterygia (Diapsida)', *Zoological Journal of the Linnean Society*, 124, pp1–41.

**122** D Naish (1997). 'Another Caddy carcass?', *The Cryptozoology Review*, 2, no 1, pp26–29.

**123** Bright, *op cit*, p211. Shuker, *op cit*. 1986. KPN Shuker (1993). 'Gambo – the beaked beast of Bungalow Beach', *Fortean Times*, 67, pp35–37. Shuker, *op cit*. 1995, p116. KPN Shuker (1996). *The Unexplained*, Carlton Books, London, p 95. KPN Shuker (1998). 'Fishy tales', *The X Factor*, 45 , p1249.

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